# Ready for Lift-Off, Orange County?:

## How a National-Local Partnership Keeps STEM Programming Innovative, Relevant, and Engaging

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### Summary

This brief report examines how a national-local partnership in Orange County, California was leveraged to adapt and deliver new, high-quality science, technology, engineering, and mathematics (STEM) learning experiences. As part of the Imagine Science network of communities, Imagine Science Orange County (ISOC) is an example of the power of youth-serving organizations across the community coming together to create learning experiences for youth historically underrepresented in STEM. Through stakeholder interviews, a document review, and examining self-report data from over 600 youth, we explore ISOC's innovative approach to partnership, curriculum adaptation, and continuous quality improvement. Data from 2019 to 2022 shows ISOC programs increased youth STEM career interest, STEM engagement, and STEM identity, and that these increases were statistically significant. Finally, we summarize the key findings, lessons learned, and future plans for ISOC.


Out-of-school time (OST) settings often feel distinct from classrooms. They have the potential to offer youth learning experiences that are more relevant and rewarding than those offered in most school settings. OST settings are also learning environments where there is more time for youth to build relationships with adults (Hein, 2009; Noam & Shah, 2014; Yohalem & Wilson-Ahlstrom, 2010). Research has shown that OST settings enhance youth's in-school academic achievement and improve their overall wellbeing (Kuperminc et al., 2019). For youth from historically underserved communities, these types of learning environments are especially critical for youth's engagement and success in science, technology, engineering, and math (STEM). For example, the relationships youth develop in OST settings are critical to youth establishing a clear and positive STEM identity and having hopeful expectations for what they can achieve in STEM in the future (Catalano et al., 2004).

OST STEM programs are often facilitated by adults who come from a variety of backgrounds, and with a range of experiences: "their familiarity with teaching, classroom management—and, most importantly, the [content]—varies" (Cooper, 2013). Further, when it comes to providing high-quality STEM learning opportunities, many OST staff likely have "no positive STEM experiences on which to draw" (Groome & Rodríguez, 2014). This lack of exposure to STEM limits OST staff's ability to lead high-quality STEM programming. Hill (2012) summarizes a dilemma common for OST staff: "while school teachers are increasingly called upon to become more proficient in subject matter, we expect OST staff to improve student outcomes…without adequate subject matter training." Therefore, professional development for OST staff has become, "the missing link to promoting STEM topics" (Coalition for Science After School, 2008). Program content, if delivered effectively, drives youth engagement in a way such that "OST staff members can do more with their background knowledge in youth development when they pair it with content-specific expertise" (Cooper, 2013).

Indeed, OST staff often deliver STEM program content in more flexible or localized ways, than would be seen in a classroom. Fitzsimons and colleagues (2020) provide guidance on best practices for this type of curriculum adaptation, which often accounts for youth's context and community. In describing their "framework approach,"

these authors share how curricular content can be adapted so that the learning experience becomes more relevant, meaningful and responsive to, as well as respectful of, the learner (Fitzsimons et al., 2020). These types of curricular adaptations are likely essential to encouraging engagement in youth historically underrepresented in STEM.

In this report, we explore how a national-local partnership developed through the Imagine Science network (see **Note 1**) supported the Orange County community in adapting and delivering new, high-quality STEM learning experiences for youth historically underrepresented in STEM. Through stakeholder interviews, a document review, and examining youth data, we explore this community's innovative approach to partnership, curriculum adaptation, and continuous quality improvement. Then, we summarize the key findings, lessons learned, best practices, and future plans for Orange County.

## Note 1. Imagine Science

Imagine Science is a network linking youth-serving organizations in communities across the country to offer "an unprecedented partnership and new way of doing business for its four governing organizations" (Clark et al., 2017). Combined, the four national youth-serving organizations that comprise Imagine Science (Girls Inc., Boys & Girls Clubs of America, YMCA, and the National 4-H Council) have the capacity to reach 18 million youth, many of whom are historically underrepresented in STEM. In addition to this large reach, the Imagine Science network aims to offer innovation in its science, technology, engineering, and mathematics (STEM) programming, enhance the existing capacity and strategies for organizations to connect with underserved youth, and promote the delivery of engaging high-quality STEM experiences.

Imagine Science's national-local partnerships allow for combining resources (such as, curricula, staff expertise) across these large youth-serving organizations and communities. Through national trainings and resources sharing, all communities adopt a similar continuous quality improvement process and common program measures. For example, all communities collect data using PEAR's Common Instrument Suite – Student Survey measuring STEM engagement, STEM career interest, and STEM identity. This has allowed for the creation of a shared framework and language through which these communities describe their successes.

Also, while communities may offer a variety of different types of STEM programming, they all share the same essential program elements:

- **Dosage:** At least 15 hours of STEM programming,
- **Target Population:** Initiative serves all age groups with a requirement that at least 50% of participants are in Grades 4-8,
- **Content:** Consistent with National Standards,
- **Research:** Demonstrated evidence of efficacy, and
- **Setting:** Fit for delivery within youth development settings.

Each community exerts local control, making programmatic and financial decisions within the network's guidelines and standards. Communities are also responsible for maintaining high-quality STEM programming and professional development. They have increased capacity to do this by leveraging the national network of communities and resources across organizations with the community itself.

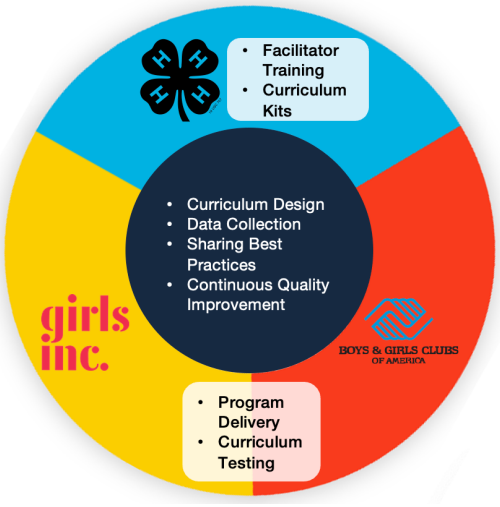
## Imagine Science Orange County

The Orange County, California community is a prime example of Imagine Science's guiding principle that youth benefit the most when youth-serving organizations collaborate effectively together. This community has had a cross-organization partnership since 2015 including the 4-H of Orange County, Boys & Girls Clubs of Garden Grove, Boys & Girls Clubs of Huntington Valley, and Girls Inc. of Orange County. Imagine Science Orange County (ISOC) was one of three pilot communities of Imagine Science, and one of its first county-wide models. It currently serves 840 youth from the Garden Grove, Fountain Valley, Huntington Beach, Westminster, Anaheim, Santa Ana, and Costa Mesa communities.

Local leadership from each of these youth-serving organizations convene to share knowledge, resources, lessons learned, and best practices across the community. Dr. Gil Noam, Founder of PEAR, who has witnessed the evolution of this partnership described that: "From the beginning, [this initiative] was values-driven and…top-down." Therefore, while many essential elements of this work occur and are controlled at the local level, this initiative also has the support and standards that are set by the national leadership at each organization and the national network of communities. This national support streamlines knowledge- and resource-sharing, trust-building, and collaboration at the local level. It also empowers local leadership to carry out their shared goal of providing high-quality STEM programming to youth who have been historically underrepresented as the "communities know their youth, and their challenges, best" (Clark et al., 2017).

While all organizations work together to improve the quality of STEM programming, each organization has unique resources to bring to the partnership. Currently, ISOC is comprised of four representatives: Heather White, Ryan Brenes, Rita Jakel, and Anna Reynolds. Noam noted in describing this group, "they are really excited about each other, respectful and trusting… [and there is an] openness to learn from each other." They each have started to take on more specialized and defined roles in their approach to their combined work. These roles have shifted over time, and they might continue to evolve as different representatives join the collaboration (**Figure 1**).

**Figure 1.** Collective Approach



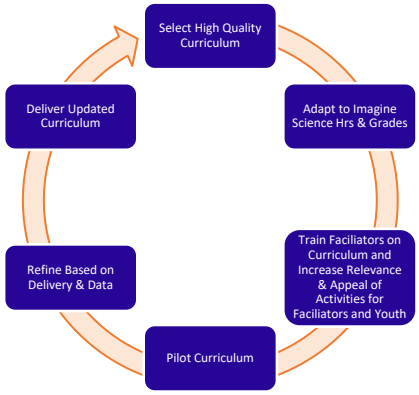

For example, Rita Jakel, Community Education Specialist from 4-H of Orange County, was a science teacher for over three decades. She has access to the National 4-H Council's STEM curriculum kits. Annually, 4-H holds a STEM Challenge where 4-H programs across the country compete to develop themed curriculum kits. These STEM curriculums are known for being innovative and relevant and provide 4-H with up-to-date content to use in their STEM programming. Jakel combines resources available from these STEM challenge kits, along with other peer-reviewed 4-H curricula. Then, she shares them with the other ISOC representatives.

Jakel also draws from the National 4-H Council's STEM curriculums to create and deliver trainings for the STEM program facilitators from Boys & Girls Clubs or Girls Inc. who will facilitate these STEM programs. In March 2023, Jakel lead a STEM Facilitation & Curriculum Training where 83% of attendees reported that they had been working at their site for less than two years. In describing these trainings, Jakel explained that the facilitators, "relate really well with the youth in the program, but a lot of them are not trained as educators…they may not have come with a STEM focus, background, or education – they may even be afraid of STEM." Therefore, Jakel plays a key role in ensuring STEM facilitators feel comfortable and confident in delivering the content of STEM programs and how they are delivered.

During the training, attendees practice the scientific process, they attempt the activities they will later facilitate with youth and use their own experiences with failure to determine how to modify and troubleshoot activities. After the March 2023 training, a survey of attendees showed that most attendees found that the training was relevant to their work, endorsed that it gave them an opportunity to practice the lessons they would be facilitating, and, finally, reported that it increased their confidence with STEM concepts.

Heather White, Senior Director of Program Impact, from Boys & Girls Clubs of Garden Grove, Ryan Brenes, Director of Operation, from Boys & Girls Clubs of Huntington Valley, and Anna Reynolds, STEM Coordinator, from Girls Inc. of Orange County are responsible for program delivery. Their organizations are successfully reaching youth that are often under-served in STEM programs. They also work with STEM facilitators and youth day-to-day, so they are tightly connected to the needs of youth in their community.

**Figure 2.** Continuous Improvement Model




Girls Inc. has traditionally integrated inquiry-based learning into its approach to STEM learning. Reynolds applies this approach not just to her work with youth, but also to her approach to continuous program improvement. She has spearheaded ISOC's process of piloting, testing, and improving the 4-H STEM curriculum that has been brought to the group (see **Figure 2**). She described how she uses her own work with youth and the experience of other ISOC representatives in an iterative process.

In one instance, Reynolds decided to revamp one activity, so the materials were better suited to her site. Specifically, she added the space lander activity in place of the communications tower activity as an engineering challenge that was better suited for her students. This modification made its way into the standard curriculum for the next site to use in their delivery of the lesson. She explained: "As I was running [the STEM curriculum], I was practicing some activities. I also was able to bring in a new activity…because I saw that one of the activities didn't quite mesh for what was working with my group." She goes on to say, "Then I brought that back to our collaborative as a group, which is something that we added into our curriculum."

White and Brenes play a critical role in the continuous improvement process. Like Reynolds, they deliver and take part in providing feedback, adapting the STEM programming, and scaling the programming across their sites. Also, Girls Inc. and the Boy & Girls Clubs are responsible for collecting youth data. Since 2019, ISOC has collected surveys from 825 youth, representing over one-sixth of the total Imagine Science youth survey data.

## Launching *Space Quest*

In January 2022, Imagine Science brought communities across their network together through a webinar to share best practices in curriculum development. ISOC participated in this webinar and heard about how 4-H agents from Imagine Science Greater Houston and Imagine Science Lancaster County had developed a curriculum called *Space Quest* by combining curricula from two related 4-H STEM Challenge kits: *Galactic Quest* and *Mars Base Camp*. These 4-H STEM Challenge kits are aligned to National Standards, and included the expertise of NASA scientists. These 4-H agents had also created and added extension activities to the curriculum so that the entire program met Imagine Science's goal of 15 hours of programming. To make the curriculum accessible to all communities in the

Imagine Science network, a resource folder was shared with everything needed to run the program, as well as information on how to prepare staff to lead *Space Quest*.

Imagine Science's *Space Quest* curriculum enables youth to learn about and explore space (**Figure 3**). In the *Space Quest* program, participants take on the role of "Space Cadets" participating in a Space Academy as they complete various missions. In each mission, Space Cadets learn about space "STEMinistas" (i.e., famous STEM figures), explore the technology and resources needed for missions, and tackle authentic obstacles STEM professionals encounter in space exploration (**Figure 4**). Throughout the curriculum, youth participants are practicing an inquiry-based learning model asking themselves "What?" "So what?" and "Now what?" as they proceed in activities.

**Figure 3.** "Space Cadets," Boys & Girls Clubs of Garden Grove, 2022

Nav Deol-Johnson, Imagine Science National Program Operations Manager, observes how each Imagine Science community is able to take the curriculum and deliver all of it or part of it to best fit the needs of the youth they serve. She describes that this process is often very "collaborative" across the network, while at the same time it allows room for localization to a particular community. According to Deol-Johnson: "…every community looks a little bit different even though they all [have the same curriculum]; it [doesn't] look the same because they add supplements."

**Figure 4.** "Space Cadets," Boys & Girls Clubs of Garden Grove, 2022

ISOC first implemented *Space Quest* in Spring 2022. The STEM curriculum needed to fit each program format used within ISOC sites: (a) camps that occur during a short, condensed school break, (b)summer camps in which recreation is more central than academics, and (c) semester- long after school programs in which participant attendance might vary across days. *Space Quest* was first piloted in a camp-type setting with Girls Inc. facilitators. Each session was 6-hours for the duration of a 4-day school break. After delivering in this format, the curriculum was refined and modified to be delivered at Boys & Girls Clubs. In the summer of 2022, two Boys & Girls Clubs of Garden Grove sites delivered *Space Quest*. The curriculum continued to be refined after this delivery so that it was even further improved by the fall. By the fall of 2022, the program was implemented at two Boys & Girls Clubs Huntington Valley sites. In total, the *Space Quest* was gradually delivered at a total of five Imagine Science Orange County sites in three formats: as a Girls Inc. Camp, Boys & Girls Clubs summer programming, and Boys & Girls Clubs academic year programming.

A post-program questionnaire was sent to past *Space Quest* participants. It consisted of eight multiple-choice and open-ended questions about their program experience (i.e., "What was your favorite part of *Space Quest*?") and takeaways (i.e., "What is one thing you learned during *Space Quest* that you still use in your science classes at school?"). In March 2023, nine youth who participated in *Space Quest* at either Girls Inc. in Spring 2022 or Boys & Girls Clubs of Garden Grove in Fall 2022 completed this questionnaire. Of the youth who disclosed their gender identity, three were boys and five were girls. As of the time they completed the questionnaire, five respondents were in fifth grade and four were in sixth grade. Respectively, these youth were likely in fourth and fifth grades while they were in *Space Quest*.

Most of the youth named the "Rover Activity" as the one that they most wanted to do again. In this activity, youth applied the entire engineering design process: they brainstormed, designed, built, tested, evaluated, and

redesigned. Three of these youth also listed "Engineer" as the career that most excites them based on what they learned in *Space Quest*. In their explanations, they noted how Engineers make their ideas a reality: "I'd get to make an abundance of unknown things, that kids like me dreamed of" and, "I can learn and experiment new things and the things I can imagine."

> **"[*Space Quest*] was wonderful, chaotic, fun, and basically the best club I've ever experienced."**
>
> –5th Grader at Boys & Girls Clubs of Garden Grove

Beyond the opportunities to practice STEM skills and form STEM career aspirations, *Space Quest* enabled youth to collaborate and develop friendships: "[*Space Quest*] would help them cooperate with their peers and gain new knowledge." A few respondents mentioned that their favorite parts were interacting with other participants. The words "fun" and "exciting" were each mentioned 11 times in relation to their experience in the program, highlighting that *Space Quest* participation afforded recreational benefits in addition to the academic and social ones.

## Common Instrument Suite Findings: Space Quest and All ISOC STEM Programming

ISOC collects data from youth using the Common Instrument Suite – Student Survey (CIS-S). The CIS-S is a youth self-report survey and the version that ISOC uses measures three scales: STEM engagement, STEM identity, and STEM career interest. The reliabilities for these scales were high, ranging from 0.80 to 0.93 (Allen et al., 2019). ISOC administers the CIS-S at the end of spring, summer and fall programming in a Retrospective Pretest-Posttest (RPP) format. The CIS-S was reported on a 4-point Likert scale from "Strongly Disagree" to "Strongly Agree."

### Overall Youth Demographics

Of the 825 Imagine Science Orange County youth who took the CIS-S between 2019 and 2022, 602 met Imagine Science's evaluation inclusion criteria (i.e., were in 4th-8th grades and participated in at least 15 hours of Imagine Science STEM programming) (**Table 1**). The majority (55%) of youth identified as girls and 41% as boys. For grade distribution, fifth graders made up 37% of the sample, followed by sixth/seventh graders (32%), and fourth graders (27%). The remainder (4%) were eighth graders. Over a third (34%) of the sample identified as Latino or Hispanic. The other main race/ethnicity groups represented in the sample included Asian, Asian-American (20%); White, Caucasian (17%); and multiracial/multiethnic (10%). The remainder (11%) included youth whose race/ethnicity was not listed and those who preferred not to answer. Over half (53%) of youth speak a language other than English at home. This large percentage mirrors Orange County's diverse population as nearly one-third of the population is comprised of immigrants (United States Census Bureau, 2022).

**Table 1.** Imagine Science Orange County (n = 602) Sample Description, 2019-2022

| Variable | *Space Quest* # of Youth (%) | Overall # of Youth (%) |
|---|---|---|
| **Year** | | |
| 2019 | N/A | 173 (29%) |
| 2021 | N/A | 231 (38%) |
| 2022 | 45 (100%) | 198 (33%) |
| **Gender** | | |
| Boy | 18 (40%) | 247 (41%) |
| Girl | 26 (58%) | 332 (55%) |
| **Grade** | | |
| Fourth | 8 (18%) | 164 (27%) |
| Fifth | 15 (33%) | 222 (37%) |
| Sixth/Seventh | 22 (49%) | 194 (32%) |
| Eighth | 0 (0%) | 22 (4%) |
| **Race/Ethnicity** | | |
| Asian, Asian-American | 13 (33%) | 119 (20%) |
| Latino or Hispanic | 18(45%) | 203 (34%) |
| White, Caucasian | 0 (0%) | 103 (17%) |
| Multiracial/ethnic | 3 (8%) | 59 (10%) |
| Prefer not to answer/not listed | 6 (15%) | 64 (11%) |
| **Primary Language** | | |
| English | 3 (8%) | 226 (38%) |
| Non-English | 34 (90%) | 321 (53%) |

### *Space Quest* Demographics

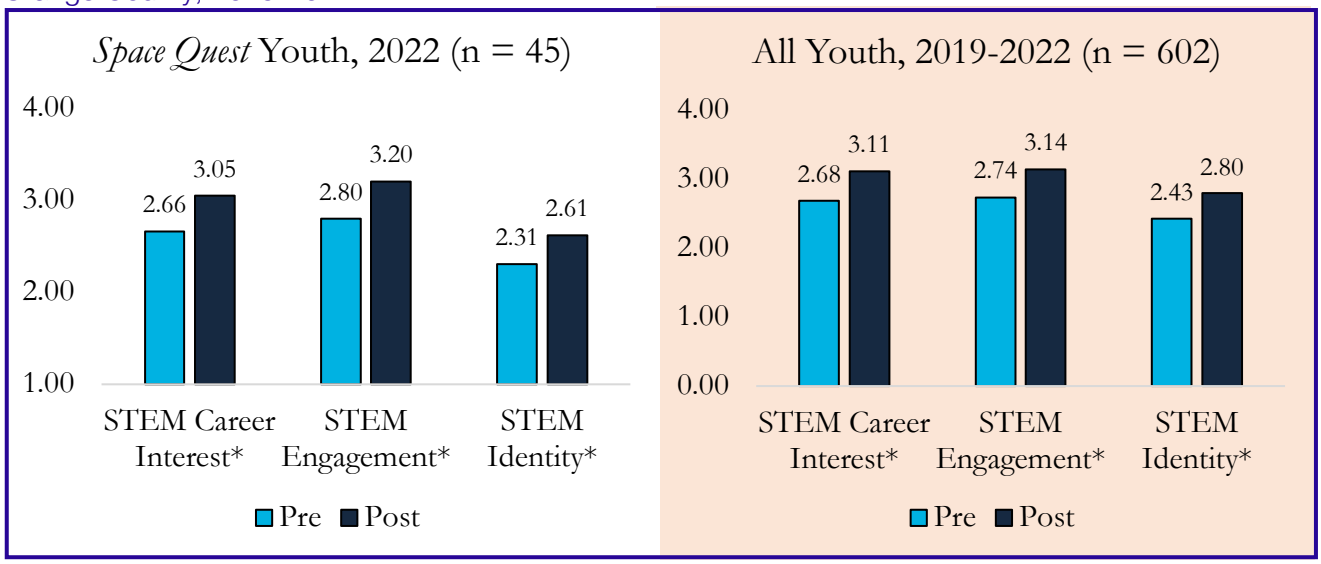
In 2022, 265 youth took the CIS-S across Orange County; 198 of these youth met the Imagine Science program inclusion criteria, meaning they were in 4th-8th grades and participated in at least 80% of the 15 hours of STEM programming. Of

these, 45 youth participated in *Space Quest* programs (**Table 1**). The majority (58%) of *Space Quest* participants identified as girls and 40% as boys. Youth in this sample were in fourth through eighth grades, with nearly half (47%) in sixth grade, a third (33%) in fifth grade, and the remainder (18%) in fourth grade. The largest race/ethnicity identity represented in the sample was Latino or Hispanic (45%). Other major race/ethnicity groups included Asian, Asian-American (33%) and multiracial/multiethnic (8%). These top race/ethnicity categories are aligned with the county demographics as there are sizeable Latino and Asian communities (United States Census Bureau, 2022). Thirteen percent of youth preferred not to disclose their race/ethnicity identity. Nearly all (90%) of youth spoke a language other than English at home.

## STEM Outcomes

To examine the changes in STEM outcomes from before and after the STEM programming, a "difference score" for each scale was calculated by subtracting the scale's retrospective-pre mean from its retrospective-post mean. Then, these difference scores were analyzed to see if they differed significantly from zero. If the *p*-value of a given scale was below 0.05, its mean difference was significant and unlikely due to chance. We first examined the outcomes of all ISOC programming. A one-sample t-test revealed that, on average, Imagine Science Orange County youth reported statistically significant positive change on all three CIS-S scales (p's < 0.001): STEM career interest, STEM engagement, and STEM identity (**Figure 5**). We repeated this analysis for youth who participated in the *Space Quest* program. Similar to the pattern we saw with all ISOC programming, we found that *Space Quest* youth reported statistically significant positive change on all three CIS-S scales (*p*'s < 0.001): STEM career interest, STEM engagement, and STEM identity (**Figure** ). To examine the magnitude of these differences, we computed effect sizes using Cohen's *d* for all ISOC STEM programs and the *Space Quest* program, respectively, and found a medium-to-large effect for the different programs (Cohen, 2009): STEM career interest (*d* = 0.79, 0.69), STEM engagement (*d* = 0.91, 0.84), and STEM identity (*d* = 0.72, 0.54).

Figure 5. Averages on STEM Outcomes Youth in *Space Quest* and All STEM Programs, Imagine Science Orange County, 2019-2022




We compared ISOC effect sizes to those found in a meta-analysis of 15 studies on measuring STEM interest in OST programs (Young et al., 2017). These U.S.-based programs served K-12 students and were comprised of summer camps, after school programs, and academic fairs. Compared to effect sizes found in a meta-analysis of high-quality, OST STEM programming (Young et al., 2017), these effect sizes are similar to the medium effect size of STEM programs that had an academic and social-emotional focus, rather than the small effect size of STEM programs that had just an academic focus. OST STEM programming often includes social-emotional elements,

such as time to develop relationships with adults and peers and opportunities for collaboration and teamwork. Research shows that these programs have a greater impact on youth engagement and interest in STEM than STEM programs in schools (Young et al., 2017).

## Discussion

Through a mixed-methods approach, we explored how the Orange County community operates within the Imagine Science network. We observed how this national-local partnership allowed for the adaptation and delivery of new, high-quality STEM learning experiences. Imagine Science, and ISOC in particular, leverages what works best in integrating STEM learning into youth development, a powerful combination that has been shown to increase STEM outcomes (Allen et al., 2019).

When OST organizations offer high-quality learning experiences that are widely accessible and have sustainable participation, they can maximize their impact on the academic, social-emotional, and health and wellness outcomes of youth (Little et al., 2008). As such, the youth that participated in ISOC programs reported significant positive change across all measured outcomes. Further, the effect sizes of these positive changes are similar to established benchmarks of high-quality OST STEM programs (Young et al., 2017).

The ISOC collaboration enhances the Orange County community's capacity for high-quality OST STEM programming. They do this through a data-driven continuous quality improvement process and by utilizing best practices in sharing content expertise, training, and curricular resources (Groome & Rodríguez, 2014). This joint effort allowed "professionals across projects … to generate and carry out creative solutions and strategies that maximize[d] benefit beyond that which each entity could accomplish" (Project Exploration & Coalition for Science After School, 2009). As one funder of Imagine Science described the partnership, ISOC represents: "the best-case example of collaboration they have seen."

The way ISOC worked together in adapting *Space Quest* showcased this approach. However, ISOC's goal goes beyond any one curriculum. As Reynolds described, they want to "build a toolbox of curricula that we can choose from, so that we can sustain the collaboration we already have and also have variety" in STEM programming. Indeed, this group is already piloting Imagine Science's next STEM program – a water curriculum (see **Note 2**) that has been shared across the Imagine Science network. The spring ISOC pilot sites will be sharing their feedback with the network this summer.

As Noam, described: ISOC has a "transformational aspiration so that [the work they do] actually penetrates each individual organization." As we have seen with Orange County, the impact of an effective local partnership can reverberate beyond any one community. The Imagine Science's network helps elevate innovation that occurs through local partnerships to its national network, which then brings the work back to local communities across the country. Therefore, among this network, innovative and best practices spread quickly. In consequence, communities are better equipped to deliver high quality STEM programming and engage youth who have been historically underrepresented in STEM.

## Acknowledgements

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## **Note 2.** Future Efforts

Following the success of their *Space Quest* curriculum, ISOC has spearheaded the development of another program, *Water Guardians*, as a means to expand their offerings of high-quality, STEM programming and continue to engage the youth their sites serve in a novel and relevant way. This curriculum explores a different content area of STEM but maintains much of the same structural elements and development process.

Like *Space Quest*, the process of developing *Water Guardians* began with a 4-H STEM Challenge curriculum kit, *Explorers of the Deep*, and other resources, such as *Rain 2 Drain*, and *Water Wizards*, at its core. Supplemental activities were then added to the curriculum to fit Imagine Science's 15+ hour criteria. ISOC sourced some of these activities from other Imagine Science communities as the ISOC leaders know that these materials are already vetted according to Imagine Science standards. Though the launch of the 4-H STEM Challenge kit in late 2022 was the initial impetus for *Water Guardians*, a water-based curriculum quickly became locally relevant to the communities that ISOC serves. In the '22/'23 winter, southern California experienced particularly heavy rainfall and, in some areas, significant flooding. Then, the activities that ISOC had been collecting about rain gardens, flood barriers, and flood control became even more topical and applicable.

By March, ISOC had structured and finalized the *Water Guardians* curriculum. Jakel then created and delivered a training for future curriculum facilitators. *Water Guardians* is currently being piloted at a few ISOC sites. Feedback from the facilitators will be collected and used to refine the curriculum as it is implemented at more sites in the summer.

Beyond its efficiency, ISOC's quarter-long process of adaptation and then further refinement of curricula allows it to be agile and deliver new STEM programming that is responsive to the current lived experiences of the participating youth. As Jakel mentions, "it's a set pattern now. Everyone that worked on [*Water Guardians*] feels like we generated a pretty good product. There's a possibility [to apply this process] in the future for other topics nationally with our 4-H educator network through Imagine Science." *Water Guardians* illustrates another instance in which an Imagine Science community is using an established process of cross-organization collaboration. Such collaboration efficiently generates new and engaging STEM programming using resources already available within the network.